Marin County
Greenhouse Gas Reduction Plan
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Prepared by the Marin County Community Development Agency
As part of the Cities for Climate Protection Campaign

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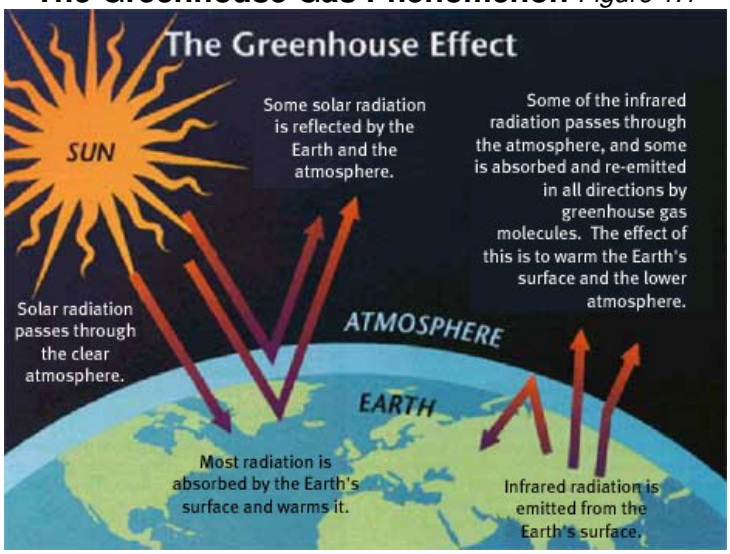
Section 1:
Introduction

Leading scientists around the world agree that climate change is a reality and that human activities are disrupting the earth's climate by intensifying the greenhouse effect. Its effects will be felt throughout our communities and while local action alone cannot solve the problem; the County of Marin is well positioned at the local level to reduce its contribution to climate change.

The Greenhouse Effect

A balance of naturally occurring gasses dispersed in the atmosphere determines the Earth's climate by trapping solar heat. This phenomenon is known as the greenhouse effect. As sunlight passes through our atmosphere, the incoming solar radiation is re-radiated from the earth's surface as heat energy. Greenhouse gases like carbon dioxide, methane, nitrous oxide, chlorofluorocarbons, and water vapor trap some of this reradiated energy. This trapped heat warms the earth, much as the glass of a greenhouse traps reradiated energy from sunlight and thereby warms the interior of the structure.

The Greenhouse Gas Phenomenon *Figure 1.1*


The Greenhouse Effect
SUN
Some solar radiation is reflected by the Earth and the atmosphere.
Some of the infrared radiation passes through the atmosphere, and some is absorbed and re-emitted in all directions by greenhouse gas molecules. The effect of this is to warm the Earth's surface and the lower atmosphere.
Solar radiation passes through the clear atmosphere.
ATMOSPHERE
EARTH
Most radiation is absorbed by the Earth's surface and warms it.
Infrared radiation is emitted from the Earth's surface.

Source: Environmental Protection Agency

Global Warming

While greenhouse gases play a vital role in maintaining the necessary conditions for life on Earth, the rapidly increasing concentrations of these gases are causing a rise in global temperature – Global Warming. Human activities are adding gases to the natural mix at an unprecedented rate. The Intergovernmental Panel on Climate Change (IPCC) states that water vapor is the most abundant greenhouse gas; it occurs naturally and makes up about two thirds if the natural greenhouse effect. Fuel burning and other human activities, however, are adding large amounts of greenhouse gases to the atmosphere—the most important ones being carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_20), and hydrofluorocarbons (HFCs). Greenhouse gases are increasing due to four major human activities:

1. *Combustion of fossil fuels.* Carbon dioxide is produced when gasoline is burned in automobiles, and when coal and natural gas are burned to heat and light our homes and businesses.
2. *Deforestation.* When vegetation is cleared, burned, or left to decay, carbon dioxide is released into the atmosphere. Vegetation also absorbs carbon dioxide. Once the vegetation is gone, less carbon dioxide will be absorbed out of the air.

3. *Decomposition of organic matter.* The decay of organic landfill waste releases both carbon dioxide and methane into the air. Methane is over 21 times more potent than carbon dioxide as a greenhouse gas.[1]
4. *Livestock.* Animals such as cows and sheep also release methane.

Scientific Facts and Projections

- The atmospheric concentration of carbon dioxide (CO_2) during the last two decades has increased at the rate of 0.4% every year.
- Current CO_2 concentrations are higher than they have been in the last 420,000 years, and according to some research, the last 20 million years.
- About three-quarters of the CO_2 emissions produced by human activity during the past 20 years are due to the burning of fossil fuels.

Source: IPCC

Climate Change and Marin County

It is now apparent that the increasing atmospheric concentration of greenhouse gasses (GHGs) resulting from human activities is changing the climate in ways that pose serious risks to Marin County's health, economy, and environment. Potential consequences could include impacts on the County's climate, sea levels, public health and electricity demands.

California Climate Projections:

- *Temperature:* Average temperatures could increase as much as 10 degrees by the end of the century.[2]
- *Sea Levels:* Calculations estimate rises ranging anywhere from approximately 1-3 feet or 8.5-35.2 in by the end of the Century.[3]
- *Fire Risk:* The occurrence of large wildfires could increase as much as 35-55%.[4]
- *Public Health:* Climate change is likely to affect the health of Californians by increasing the frequency, duration, and intensity of conditions conductive to air pollution, harsh heat, and wildfires.[5]
- *Electricity Demand:* Under the worst cast scenario, electricity requirements in 2010 would increase by approximately 7,500 GWh, and would require an additional peak capacity of 2,400 MW.[6]

Marin County's Commitment to Sustainability

In May 1999, the Marin County Board of Supervisors unanimously approved a set of sustainability recommendations. Through these recommendations, the Board of Supervisors committed the County to undertake actions such as: public environmental education, improving County operations, and using sustainability as the foundation for the current update of the Countywide Plan.

During Earth Week 2002, the Marin County Board of Supervisors signed a resolution to join the Cities for Climate Protection Campaign (CCP). This campaign is administered under the International Council for Local Environmental Initiatives (ICLEI) and attempts to reduce international greenhouse emissions through actions by local governments. As of July 2006, there are 561 local governments involved in CCP activities the world, including 134 in the United States and 30 in California. The U.S. participants account for 17% of total U.S. greenhouse gas (GHG) emissions.

CCP calls on municipalities to proceed through five milestones to reduce their contribution to climate change:

1. *Analyze greenhouse gas emission levels.* Determine current greenhouse gas (GHG) emissions and forecast the growth in emissions that will occur without preventative action.

2. *Set a reduction target.* The target is the specific reduction that Marin aims to achieve by a designated year; e.g. 20 percent GHG reduction by 2020.
3. *Develop a local action plan*. This plan is a description of policies, programs, and measures that Marin will implement in order to meet its target.
4. *Implement the local action plan.* Follow through on the proposed actions.
5. *Monitor the progress and report results.* Determine the success of the plan.

Marin County has conducted an emissions inventory (See - Milestone 1) and has developed a GHG reduction target (See - Milestone 2). Many actions that reduce GHG emissions have already been initiated by the County and by organizations and individuals in the community. This local action plan (See - Milestone 3) outlines activities that can help achieve Marin County's target.

State and Federal Mandates for Sustainability

The state of California has taken the lead in setting specific targets for reducing greenhouse gas emissions from the burning of fossil fuels in both power plants and vehicles. California has been leading the charge on combating climate change through the following legislation:

- *California Solar Initiative Program, 2006*. Comprehensive $2.8 billion program that provides incentives toward residential and commercial solar development over 11 years.
- *Senate Bill 1078 Sher, 2002*. Established a Renewable Portfolio Standard requiring electricity providers to increase purchases of renewable energy resources by 1% per year until they have attained a portfolio of 20% renewable resources.
- *Assembly Bill 1493 Pavley, 2002*. Requires the State Air Resources Board to develop and adopt regulations that achieve the maximum feasible reduction of greenhouse gasses from vehicles primarily used for non-commercial transportation by January 2005.
- *Senate Bill 1771 Sher, 2000*. Requires the California Energy Commission (CEC) to prepare an inventory of the state's greenhouse gas emissions, to study data on global climate change, and to provide government agencies and businesses with information on the costs and methods for reducing greenhouse gases. It also established the California Climate Action Registry to serve as a certifying agency for companies and local governments to quantify and register their greenhouse gas emissions for possible future trading systems.
- *AB 32 Nuñez & Pavley, 2006*. Institutes a mandatory limit on greenhouse gas pollution – reducing emissions in California to 1990 levels by the year 2020, or 25% below forecasted levels. The bill also directs the California Air Resources Board (CARB) to establish a mandatory reporting system to track and monitor emission levels and requires CARB to develop various compliance options and enforcement mechanisms.

Currently, there is no federal mandate for greenhouse gas emission reporting or reduction in the United States. Local action in addition to strong support from State legislation will help Marin County achieve its CO_2 reduction targets.

Section 2:
GHG Emissions in Marin County

The first step in reducing greenhouse gas emissions is to determine the quantity of greenhouse gas emissions Marin County is currently emitting and to identify which sectors are responsible for the bulk of these emissions. This information was collected by the Marin Community Development Agency (CDA) as a basis for identifying possible reduction measures, which are listed in Section 3 & 4.

GHG Emissions Inventory

The greenhouse gasses analyzed in Marin County's GHG emissions inventory include carbon dioxide, methane, nitrous oxide, and various hydrofluorocarbons. All emission levels are reported in equivalent carbon dioxide (eCO_2) units. Since CO_2 is the most significant GHG in terms of our emissions, it is used as the standard. Converting all emissions to carbon dioxide units allows for comparison between greenhouse gasses of varying strengths.

An inventory of 1990 greenhouse gas emissions calculates countywide levels at approximately 2.6 million tons of eCO_2. Figure 2.1 summarizes the results of the emissions analysis. Overall, Marin County has experienced a 15% increase in GHG emissions from 1990 to 2000.

Results of Emissions Analysis *Figure 2.1*

Countywide (Tons)		
Year	**1990**	**2000**
Unincorporated	617,562	639,741
Incorporated	2,237,162	2,473,825
Total	2,634,003	3,113,565
Percentage Growth	+15%	
Internal (Tons)		
Total	16,945	18,451
Percentage Growth	+8%	

Figure 2.1 also displays emission figures for internal County operations. Within the Countywide inventory, figures for emissions being released by County of Marin vehicles and buildings were extracted. An 8% increase in GHG emissions occurred by Marin County facilities and internal government operations.

Countywide Emissions Analysis, 2000 *Figure 2.2*

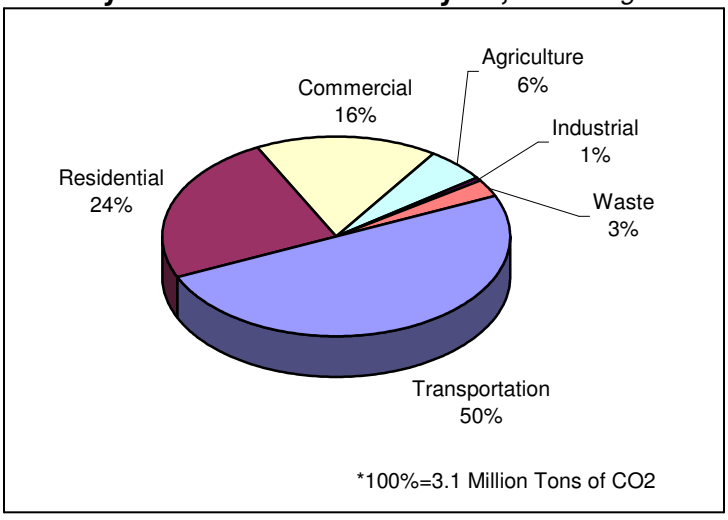


Figure 2.2 displays countywide emissions broken down by industry. The transportation sector accounts for 50% of Marin County's GHG emissions making it the largest contributor.

Greenhouse Gas Emissions Reduction Target

A target has been set to reduce GHG emission 15-20% below 1990 levels by the year 2020 for internal government and 15% countywide. This target exceeds the state target for GHG reductions. The inventory shows that in order to reduce GHG emissions, Marin County needs to address transportation issues as well as residential and commercial energy use. Section 3 of this plan lists resources and programs available to support measures, and describes potential actions that can be taken to further reduce emissions.

Section 3:
Meeting the Reduction Target

Internal measures already in place through the Department of Public Works (DPW) will likely result in the County's achievement of the internal reduction target at the low end of the 15-20% range. The measures listed in the next section are intended to provide internal government options for additional GHG reductions beyond a 15% reduction.

Reaching the countywide target, however, will require significant additional efforts by the County, cities and towns within the county, and the State government. For example, the implementation of Community Choice Aggregation or the purchase of green tags could allow Marin to achieve its Countywide target. Launching a car-share program or using local landfill and wastewater treatment facilities for energy production could also have a significant impact. Local cities could adopt many of the measures listed below to increase the impact on countywide emissions levels. Support for vehicle fuel efficiency standards at the State level could have a wide-reaching impact on Marin's countywide emissions levels.

Existing measures in place through the Community Development Agency (CDA) will help reduce the countywide emissions level. These measures range from energy efficiency programs and green business support to solar rebates and green building incentives and ordinances. Many such measures are included in the draft Countywide Plan. Existing measures in place through AB 32 and other state initiatives will also contribute to a countywide reduction. It is estimated that overall, such existing measures will result in a GHG reduction that is 21% below the expected 2020 level. This is significant; however, it is 1,190,639 tons shy of the target, which is set at 15% below the 1990 level.

All of the potential measures listed in the next section will add to Marin's GHG reduction and are consistent with one or more Countywide Plan update programs. For reference, the Countywide Plan programs are listed below according to their section and number. Programs which have already been enacted are marked with an asterisk.

Agriculture
- AG-1.q: Support irrigation alternatives.

Atmosphere & Climate
- AIR-3.c: Consider model clean vehicle requirements.
- AIR-4.a: Reduce greenhouse gas emissions resulting from energy use in buildings.*
- AIR-4.b: Reduce greenhouse gas emissions resulting from transportation.
- AIR 4.c: Reduce methane emissions released from waste disposal.
- AIR-4.e: Reduce County government contributions to greenhouse gas emissions. *
- AIR-4.k: Encourage the planting of trees with urban forestry practices.

Community Development
- CD-1.a: Keep urban uses in the city-centered corridor.*
- CD-1.b: Preserve resources in the Baylands corridor.
- CD-2.g: Identify and plan mixed use sites.*

Design
- DES-2.b: Define flexible-use building types.
- DES-3.a: Encourage mixed use projects. *

Economy
- EC-1.k: Provide assistance with green practices.*

Energy & Green Building
- EN-1.e: Offer energy efficiency information, technical assistance, training and incentives.*
- EN-2.f: Use renewable energy in county facilities.*
- EN-2.d: Facilitate renewable energy technologies and design.*

- EN-2.e: Provide incentives for alternative energy production.*
- EN-2.g: Explore Community Choice Aggregation.*
- EN-3.c: Divert construction waste.*

Housing

- HS-3.a: Complete a non-residential job/housing linkage study.
- HS-3.o: Conduct a survey of potential mixed use sites.
- HS-3.q: Establish mixed use development standards and incentives.
- HS-3.v: Evaluate the feasibility of an "Affordable Housing Overlay Designation".

Public Services and Facilities

- PSF-4.b: Divert construction waste. *
- PSF-4.c: Reduce waste at county landfills.*
- PSF-4.d: Offer recycling education.*

Transportation

- TR-1.a: Support alternate work schedules.
- TR-1.c: Promote transportation alternatives.*
- TR-2.b: Adopt standards for pedestrian and bicycle access.
- TR-2.k: Consider pedestrian needs.
- TR-2.j: Ensure safe routes to schools.*
- TR-3.f: Promote transit-oriented development.
- TR-4.c: Support green fuels.*

Water

- WR-3.a: Support water conservation efforts.
- WR-3.b: Support and integrate water district conservation efforts.

*Program has already been enacted.

Reduction Measures

Based on the distribution of emissions revealed in CDA's emissions inventory, existing priorities and resources, and the potential costs and benefits of various potential emissions reduction projects, the County in collaboration with ICLEI identified this set of potential GHG reducing measures to supplement efforts already underway.

Each potential measure is presented here along with the potential reduction of eCO_2 that could be achieved. The four most significant energy dependent categories included in the analysis are: building energy use, transportation, waste management, and land use. These potential measures will offer reductions in addition to those already proposed or achieved by existing County and statewide measures.

Building Energy Use

Stationary energy use by buildings in all sectors (residential, commercial and industrial) accounts for 44% of the total GHG emissions in Marin. Marin County relies on electricity, natural gas, and fuel oil for energy. Most energy in the County is imported, and Pacific Gas and Electric (PG&E) is the sole distributor of electricity and natural gas locally. 47% of PG&E's energy supply for Marin County comes from natural gas, one of the single largest contributors to greenhouse gas emissions.

The County has experienced an overall increase in energy use from 1990 through 2000 of 10%, from 1.23 megatons of eCO_2 to 1.38 megatons of eCO_2. In 2000, unincorporated Marin is responsible for approximately 17% of emissions from stationary energy sources.

County DPW remains proactive in implementing GHG emissions reduction projects in County buildings. CDA efforts already in place such as the Marin Energy Watch Partnership, Single Family Dwelling Energy Efficiency Ordinance, Solar Energy Rebate Program, Green Building Program and future sustainable affordable housing projects, will help in reducing residential and commercial building energy use and subsequently GHG emissions throughout the County.

Proposed Building Energy Use CO2 Reduction Measures *Figure 3.1*

New Measure	Supporting CWP Program	Potential Annual CO2 Reduction (Tons)	Existing Annual CO2 Reduction (Tons)
Implement tidal power project	AIR-4.a, EN-2.d	446,408	n/a
Implement a form of community choice aggregation	EN-2.g	294,165	n/a
Purchase "green electricity" from solar, geothermal, wind, hydroelectric sources through green tags (60%)	AIR-4.a, AIR-4.e, EN-1.j, EN-2.f	4,260	n/a
Or - Purchase "green electricity" from solar, geothermal, wind, hydroelectric sources through green tags (20%)	AIR-4.a, AIR-4.e, EN-1.j, EN-2.f	1,420	n/a
Initiate a community energy efficiency rebate program	AIR-4.a, EN-1.e, EN-2.e	3,320	830
Install solar panels on municipal facilities	AIR-4.a, AIR-4.e, EN-1.j, EN-2.f	1,100	736
Install energy-efficient street lights	AIR-4.a, AIR-4.e, EN-1.j, EN-2.f	n/a	182
Install green or reflective roofing	AIR-4.a, AIR-4.e, EN-1.j, EN-2.d, EN-2.f	n/a	34
Perform energy-efficient lighting retrofits	AIR-4.a, AIR-4.e, EN-1.j, EN-2.f	190	22

Transportation

Emissions from transportation come from vehicles that use gasoline and diesel. Transportation is responsible for 53% of total greenhouse gas emissions in Marin County. Current trends are toward lower fuel economy and more vehicle miles traveled, which means more emissions of GHG's and other air pollutants. Car ownership is increasing at a faster rate than Marin County's population.

From 1990-2000, the County experienced a 6% overall increase in transportation emissions. As of 2000, transportation within the unincorporated areas of Marin accounted for approximately 15% of total Countywide emissions, based on CalTrans vehicle studies.

Proposed Transportation CO2 Reduction Measures *Figure 3.2*

New Measure	Supporting CWP Program	Potential Annual CO2 Reduction (Tons)	Existing Annual CO2 Reduction (Tons)
Improve traffic signal synchronization / decrease stop rate and time	TR-2.k	16,000	n/a
Encourage community car-sharing (run a program as municipality/ support for-profits that give car-sharing services, eg Zipcar)	AIR-4.b, TR-1.c	11,880	n/a
Expand local or regional bus service in range and/or frequency	AIR-4.b, TR-3.a	10,000	n/a
Offer prioritized parking for hybrid cars	AIR-4.b	4,615	n/a
Encourage car-pooling or van-pooling by municipal employees	AIR-4.b, AIR-4.e, TR-1.c	1,192	1192
Expand community bicycle infrastructure (e.g., dedicated bicycle lanes, additional bicycle parking spaces)	TR-2.b, TR-2.c, TR-2.d, TR-2.e, TR-2.g, TR-2.h, TR-2.I, TR-2.l	400	n/a
Expand the "safe routes to school" program	TR-2.b, TR-2.j, TR-2.k	239	239
Purchase fuel efficient (e.g., hybrid) and/or smaller fleet vehicles	AIR-4.b, AIR-3.c, AIR-3.c, AIR-4.e, TR-4.c	173	69
Encourage telecommuting by municipal employees	AIR-4.b, TR-1.a	48	n/a

Waste Management

The disposal of waste results in the direct release of greenhouse gasses when it is burned in incinerators and when it degrades in landfills and produces methane. The manufacturing, processing, and transporting of new goods also creates emissions. In 2000, waste was 4% of Marin's GHG emissions, which means it serves as a net loss of eCO_2.

Marin County leads the state in the diversion of waste from landfills, currently at a rate exceeding 75%. CDA efforts already in place such as the Construction and Demolition Waste Ordinance will help further reduce GHG emissions associated with waste generation throughout the County.

Proposed Waste to Energy CO2 Reduction Measures *Figure 3.3*

New Measure	Supporting CWP Program	Potential Annual CO2 Reduction (Tons)	Existing Annual CO2 Reduction (Tons)
Establish/expand recycling programs in the community	AIR-4.c, PFS-4.d	119,300	140,770
Implement solid waste reduction program through creation of reuse facilities /programs	AIR-4.c, PFS-4.c, PFS-4.d	33,000	n/a
Establish system for reuse or recycling of construction and demolition materials	EN-3.c, PFS-4.b	30,000	150,000
Produce electricity from recovered methane in local landfills	AIR-4.c	5,300	n/a
Install an anaerobic digester at wastewater treatment facilities	PFS-4.h	3,200	n/a

Land Use

Land use measures such as those relating to housing, community development and public facilities have the potential to directly correlate with the County's GHG emissions. Although the impact of the measures listed below are difficult to quantify and therefore list do not have their potential eCO_2 reductions, implementing them can significantly alter the County's emissions totals.

CDA efforts already in place such as master planning for mixed-use development projects and a proposed housing overlay designation in the draft Countywide Plan will help in reducing GHG emissions throughout the County.

Proposed Land Use CO2 Reduction Measures *Figure 3.4*

New Measure	Supporting CWP Program	Potential Annual CO2 Reduction (Tons)	Existing Annual CO2 Reduction (Tons)
Foster downtown neighborhood development	HS-3.o, HS-3q	775	n/a
Encourage mixed-use development	CD-2.c, CD-2.g, CD-5.b, DES-2.a, DES-2.b, DES-2.c, DES 3.a, HS-3.o, HS-3p, TR-3.f	n/a	n/a
Promote transit-oriented development	DES.2.a, CD-5.b, DES-2.a, HS-3.m, TR-3.f, EC-1h	n/a	n/a
Encourage water conservation	WR-3.a, WR-3.b, AG-1.p, AG-1.q	n/a	n/a
Establish city-centered corridors	CD-1.a	n/a	n/a
Institute growth boundaries, ordinances or programs to limit suburban sprawl	AIR-4.l, AIR-4.m, OS-2.b, OS-2.c, OS-2.g, OS-2.h, CD-1.a, CD-1.b, CD-	n/a	n/a
Implement Housing Overlay Zone focused on city centered corridor	CD-2.d, HS-3.v	n/a	n/a
Maintain a jobs/housing balance	CD-5.f, HS-3.a, HS-3.b	n/a	n/a
Plant trees for energy savings	AIR-4.k, BIO-4.l, DES-3.e	n/a	n/a

Section 5:
Conclusion and Next Steps

Climate change is an issue that Marin County is taking seriously and has shown significant leadership in addressing. This Greenhouse Gas Reduction Plan is intended to serve as a guide to help Marin County pursue work plans with the objectives of conserving resources and further abating global warming.

As mentioned previously, activities are already underway to help Marin meet or exceed the target greenhouse gas reductions. Such measures include solar rebates, DPW's and CDA's energy efficiency programs, CDA's green business support and green building incentives and ordinances. Many such measures are included in the draft Countywide Plan which is likely to further their impact.

In some cases, implementation will require the cooperation of other agencies, private businesses, and residents. And, although some of the initiatives in this document are already being implemented by County departments, others will require additional resources. The success of these measures will be tracked using indicators and targets such as these in the draft Countywide Plan: reduce total countywide energy use by 2% per year to achieve 20% by 2015; increase total megawatts of photovoltaic systems to 15 MW by 2010 and 30 MW by 2015; and decrease fuel consumption by county-owned vehicles 10% by 2010 and 15% by 2015.

Further, the actions are intended to be implemented over a period of several years. During that time, it is likely some measures will evolve as circumstances change and new opportunities present themselves. Therefore, monitoring of progress and periodic evaluation of measures will be carried out to ensure successful and continued greenhouse gas reduction.

Appendix A:
Data Collection Process

Measures identified in this plan were developed by three University of California at Berkeley graduate students in collaboration with the County and ICLEI. Using available data from state and county sources, a list of potential measures were developed for this plan.

Energy
Proposed measures were selected by performing an analysis of Marin County's electricity and transportation use. Specific data for the County's energy use was provided by the California Energy Commission (CEC) and was divided into industry categories (residential, commercial, industrial, agriculture and unclassified). Similar data for the entire State of California's energy trends were also used to determine potential measures. Indicator values for residential energy use (population and number of households) for 1990 and 2000 were determined from the United States Census.

Transportation
Local transportation figures such as data on the County's total vehicle miles traveled (VMT) were used to establish potential measures. VMT figures for Marin County were found in the California Department of Transportation (CalTrans), Division of Transportation System Information, Office of Travel Forecasting & Analysis, Highway Inventory & Performance Branch Database (HPMS Database) at http://www.dot.ca.gov/hq/tsip.

Waste Management
Potential waste to energy measures were developed with the assumption that there are 16,000 cows in the County. The measures also assume that there could be multiple systems operating at 300kW for 11 hours per day year- round. This would result in an average of 1.2 million kWh per year reduction. These reductions are based on Marin County's Straus Dairy energy system savings.

Proposed Measures Selection Process
The proposed measures included in this plan were selected based on the following selection criteria:

Cost Criteria
- Cost for implementation to local government
- Percent pay-back per year
- Cost effectiveness

Additional Selection Criteria
- Potential Emissions Reduction
- Uniformity with Existing Priorities
- Ease of Implementation
- Assistance/ Support Available
- Examples of Others Doing It
- Funding Sources
- Visibility
- Community Reaction
- Implementation Timeframe

In addition to these decisive factors, a set of "pre-selection criteria" was used. It was determined that all local measures were to be derived from a long list of best practices found in other jurisdictions. In addition, suggestions from Marin County were also used to create measures. The initial list included approximately 100 potential measures

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